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INTEGRATING BASIC AND APPLIED RESEARCH AND THE UTILITY OF LATTAL AND PERONE'S HANDBOOK OF RESEARCH METHODS IN HUMAN OPERANT BEHAVIOR

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Lattal and Perone's *Handbook* of methods used in human operant research on behavioral processes will be a valuable resource for researchers who want to bridge laboratory developments with applied study. As a supplemental resource, investigators are also encouraged to examine the series of papers in the *Journal of Applied Behavior Analysis* that discuss basic research and its potential for application. Increased knowledge of behavioral processes in laboratory research could lead to innovative solutions to practical problems addressed by applied behavior analysts in the home, classroom, clinic, and community.

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Lattal and Perone's (1998) *Handbook* will make the goal of integrating laboratory research on behavioral processes into application easier to achieve. The authors contributing to the *Handbook* have done an admirable job of illustrating the laboratory methods used in their respective areas of specialty. Each chapter provides a beneficial primer of methods that are currently used in analyses that clarify how the principles of behavior determine what humans do and what they say (publicly and privately). The knowledge gained from the methods and analyses described can help to solve the practical problems addressed by applied behavior analysts. Applied behavior analysis "grows not only by expanding the application of known principles to new areas . . . but also by expanding the very principles used to understand behavior" (R. H. Horner, 1997, p. 592). Studying the material in Lattal and Perone's *Handbook* can help to lay the foundation for such expansions.

In their preface, Lattal and Perone (1998) state clearly that the book is about the methods used to study human operant behavior in laboratory settings and the accompanying theoretical underpinnings of the research. The book is not about application. The contributing authors rarely make contact with the applied literature, either conceptually or methodologically. Doing so would have been a reasonable alternative approach to the one taken by Lattal and Perone. Many authors of basic research articles discuss the relevance of their data for application; it would have been informative to read the present authors' views on areas of potential applied research. Nevertheless, the format adopted for the *Handbook* works well for the editors' purpose of communicating primarily to laboratory rather than applied scientists.

Fortunately, the editors of the *Journal of*

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Applied Behavior Analysis (*JABA*) have encouraged a substantial amount of bridge material, which makes explicit connections between areas of laboratory work and their potential application. There is considerable support in the *JABA* community for integrating basic and applied behavior analyses (e.g., Mace & Wacker, 1994; Wacker, 1996). The entire Winter 1994 issue of *JABA* was devoted to this enterprise, and the research articles featured in that issue dealt with the topics of choice, resistance to change, stimulus control, and adjunctive behavior. There was also a section of the Fall 1997 issue of *JABA* devoted to choice, which led off with Fisher and Mazur's (1997) extensive discussion of the topic. Finally, a broad range of topics have been discussed in articles contributing to the "Developments in Basic Research" series that began in the Summer 1993 issue. Applied researchers have also called for basic researchers to consider ways of bringing the fruits of their laboratory work to the classroom, home, and clinic (e.g., Mace, 1994; Wacker, 1996).

Because Lattal and Perone's (1998) *Handbook* is about research on basic process and not applied research, I decided to do a bridge review of the book. The book's value as a resource might be enhanced if the applied scientist also took advantage of the substantial amount of bridge material available in *JABA*. My review recommends many linkages among chapters in the book to the potentially helpful commentaries on basic research and other selected review and discussion papers published in *JABA*. The breadth of topics presently addressed in the laboratory is reminiscent of the range of research topics that have been of interest to the *JABA* readership over the years. Supplementing a chapter in the *Handbook* with one or more of the *JABA* discussion papers might help to rekindle some of those research interests.

Table 1 reflects the Handbook's organization of 19 chapters into five sections. There are also citations to 12 different discussion papers published in *JABA* as part of the "Developments in Basic Research" series. The series began with an article by Hineline and Wacker (1993), and others followed the same format or expanded upon it. One or more recent articles from the *Journal of the Experimental Analysis of Behavior* (*JEAB*) were summarized, and the relevance for applied work was discussed. The *JEAB* articles were typically empirical in nature and involved either laboratory animals or humans. Some of these articles are listed more than once in Table 1 because of the diversity of the articles highlighted in a paper (e.g., Nevin & Mace, 1994, on behavioral momentum, contextual stimuli, prey detection). Table 1 suggests only a few of the possible connections among the chapters in the *Handbook* and discussion papers, and only some of these are emphasized below.

Basic Considerations

The first three chapters of the *Handbook* provide relevant background and overview of the material to be covered in the book. Human laboratory work is distinguished from other areas of behavior analysis, and fundamental concerns involving protocol implementation and data analysis are addressed. I recommend that all applied researchers read this section (see Table 1). Most of the material is general in nature, and the authors have skillfully crafted their contributions.

Chapter 1. Lattal and Perone discuss issues to be addressed in the other chapters. Ranging from basic studies using contrived protocols to bridge studies using methods that resemble those of applied research, they emphasize the objective of clarifying basic principles (Fisher & Mazur, 1997; Wacker, 1996). For applied researchers, the authors admit that the natural attraction to human rather than nonhuman studies may at first

blush give the human work face validity. However, as Lattal and Perone note, "Face validity often represents what Bachrach (1981) called the 'analogue error': Similarity of topographical appearance of two phenomena may belie significant differences in controlling variables" (p. 10). They also acknowledge a special role for verbal behavior, "both in terms of its relation to nonverbal operant behavior and in terms of its importance as a subject matter in its own right" (p. 10). This view of verbal behavior becomes a major theme throughout the book.

To avoid making analogue errors, both basic and applied scientists seek to understand the differences in controlling variables of topographically similar behaviors. Different variables may control topographically similar behaviors exhibited either by different populations of individuals (e.g., children and adults) or the same individuals in different settings. As a practical example, the variables that exercise control over a student's verbal repertoire exhibited in a resource room used for speech and language therapy may be vastly different from the variables that control the same repertoire in the regular classroom or home. Similarly, the variables that operate during an analogue functional analysis of aberrant behavior may differ from those that operate in the natural environment. The implications are far-reaching and are sometimes overlooked. The design of effective and broadly applicable interventions requires a thorough understanding of these differences in controlling variables that exist across individuals and situations (e.g., Kirby & Bickel, 1988; Stokes & Baer, 1977).

Chapter 2. Pilgrim discusses matters pertaining to the handling of research participants (e.g., adults, children, and individuals with disabilities) such as recruitment, scheduling, compensation, and establishing and maintaining rapport. Pilgrim's comprehensive collection of practical tips will be especially useful to investigators (basic or applied) who are just starting a research program with humans. Experienced investigators will also find the information invaluable, particularly if their work involves an unfamiliar human population.

Chapter 3. Baron and Perone address issues of experimental design and analysis. They make the important point that some research goals may require the use of between-group comparisons rather than individual designs (e.g., variables such as chronological age, clinical diagnosis, and irreversible effects). For example, a broad arsenal of analytic tools may be desirable if one seeks to participate in the full range of research activities required to transfer basic research knowledge into a useful behavioral technology (e.g., Johnston, 1991, 1993; Mace, 1991). Traditional single-subject designs will not suffice for the program evaluation, curriculum design, or technology dissemination that can be involved.

Baron and Perone also point out that the field of human operant research, as many of the chapters illustrate, typically uses analytic methods that focus on "convenient" rather than "interesting" behavior. The former is exemplified by button pressing and the latter by communicative exchanges during social situations. Applied research, of course, typically focuses on interesting behaviors and members of interesting populations who exhibit these behaviors (e.g., individuals with mental retardation and autism).

I would emphasize, however, that applied researchers are also often interested in convenient responses like pressing a button, clicking a mouse, and touching a computer screen. For example, assessment often makes use of such responses when trying to discern the strengths and weaknesses in a student's language and academic repertoire. Other candidates that might benefit from such basic research include the users of assistive technology and augmentative and alternative

Table 1

The Chapters (Numbered) Are Listed As They Appear in Lattal and Perone's (1998) *Handbook* (Authors in Parentheses). The References Are from the "Developments in Basic Research" in *JABA.*

Basic Considerations

1. Analysis of Human Operant Behavior (Lattal & Perone)
2. The Human Subject (Pilgrim)
3. Experimental Design and Analysis (Baron & Perone)

Reinforcement and Punishment

4. Reinforcement: Schedule Performance (Shull & Lawrence)
   (a) Hineline and Wacker (1993): preparedness, schedules, economics, delayed reinforcement, acquisition
   (b) Shull and Fuqua (1993): collateral effects, adjunctive behavior
   (c) Hayes and Hayes (1993): delayed reinforcement, acquisition
   (d) Iwata and Michael (1994): response deprivation, economics
   (e) Nevin and Mace (1994): behavioral momentum, resistance to change
   (f) Lattal and Neef (1996): behavioral history, dynamic schedules
5. Choice and Self-Control (Mazur)
   (a) Hineline and Wacker (1993): preparedness, choice, delayed reinforcement, probability of reinforcement
   (b) Hayes and Hayes (1993): delayed reinforcement, conditioned reinforcement
   (c) Shull and Fuqua (1993): matching law, schedule-correlated stimuli
   (d) Iwata and Michael (1994): microeconomics, substitutability of reinforcers, generalized matching law, conditioned reinforcement, delay-reduction theory
   (e) Pierce and Epling (1995): choice, matching law, maximizing, concurrent schedules
   (f) Lalli and Mauro (1995): unreliable reinforcement, conditioned reinforcement, delay reduction, delayed reinforcement
6. Negative Reinforcement and Punishment (Crosbie)
   (a) Shull and Fuqua (1993): response cost
   (b) Friman and Poling (1995): response effort, response force, response requirement
   (c) Lattal and Neef (1996): negative reinforcement, punishment

Stimulus Control

7. Stimulus-Control Procedures (Saunders & Williams)
   (a) Iwata and Michael (1994): selective associations, stimulus salience, biological constraints
   (b) Nevin and Mace (1994): contextual stimuli, discrimination, generalization, differential outcomes
   (c) Cataldo and Brady (1994): naming, response requirement, matching to sample, learning set, visual acuity
8. Stimulus Equivalence (Green & Saunders)
   (a) Hayes and Hayes (1993): equivalence, negative stimuli, relational frames
   (b) Stromer, Mackay, and Remington (1996): naming, complex stimuli, differential outcomes, observational learning, generalization
9. Remembering and Forgetting (Wixted)
10. Signal Detection (Irwin & McCarthy)
    (a) Nevin and Mace (1994): stimulus control, prey detection
    (b) Cataldo and Brady (1994): self-reports, matching to sample

Verbal and Social Behavior

11. Infants and Children (Weisberg & Rovee-Collier)
12. Verbal Governance of Behavior (Shimoff & Catania)
    (a) Hineline and Wacker (1993): observing, delay of reinforcement, information, response effort
    (b) Shull and Fuqua (1993): choice, instructions, rule-governed behavior
    (c) Hayes and Hayes (1993): delayed consequences, verbal behavior
    (d) Lattal and Neef (1996): instructions
13. Taxonomy of Verbal Behavior (Catania)
14. Self-Report (Critchfield, Tucker, & Vuchinich)
    (a) Shull and Fuqua (1993): choice, verbal reports
    (b) Cataldo and Brady (1994): self-reports
    (c) Kirby and Bickel (1995): self-reports, private events, multiple operants
15. Social Behavior (Schmitt)

New Directions

16. Continuous Observation of Human Behavior (Bernstein)
17. Behavioral Ecology (Hackenberg)
    (a) Hineline and Wacker (1993): concurrent schedules, patches, repletion, depletion, choice, generalized matching
    (b) Pierce and Epling (1995): concurrent schedules, matching, foraging
    (c) Iwata and Michael (1994): foraging

Table 1
(Continued)

18. Pharmacology (Higgins & Hughes)
    (a) Kirby and Bickel (1995): drug discrimination, reinforcement, punishment, choice, economics
19. Self-Experimentation (Roberts & Neuringer)

Note. The descriptors that accompany the references are not comprehensive; some were taken from the abstracts of the *JEAB* articles highlighted in the discussion papers, and some were derived from the discussion articles themselves.

forms of communication. Further possibilities for application will emerge as researchers doing basic and bridge studies take greater advantage of the computer graphics and sounds and input devices now available (e.g., voice recognition, electronic pen and pad). Thus, what is learned about behavioral processes in the context of convenient responses in the laboratory may be more directly applicable to problems of social significance than it initially appears.

Reinforcement and Punishment

As might be expected, there are substantially more *JABA* papers relevant to the role of consequences on behavior than other topics. The discussion papers listed in Table 1 also exemplify the creative applied research that may derive from integrating basic and applied research. In addition, several other informative discussions may be found on extinction (Lerman & Iwata, 1996; Spradlin, 1996), behavioral momentum (Nevin, 1996; and see Houlihan & Brandon, 1996; Mace, 1996), and choice (Fisher & Mazur, 1997). The topics under consideration in these *JABA* papers have already had a substantial impact on application in areas such as reinforcement assessment, functional analysis, choice making, compliance, and the treatment of behavior disorders. The productive interplay between applied and basic research already evident on topics such as reinforcement, schedules, punishment, choice, and self-control is likely to continue.

Chapter 4. Shull and Lawrence write about performance on reinforcement schedules. They agree that a primary reason for interest in this topic relates to applied work, in which a better understanding of intermittent-schedule performance might have implications for addressing the issues of generalization, maintenance, and persistence of behavior. Because applied researchers are constantly challenged to devise interventions that achieve these outcomes, they will appreciate all the help they can get from the laboratory scientist. Research on the relation between verbal behavior and schedule performance is described and analyzed as well. With respect to application, Lattal and Neef (1996) acknowledged the importance of basic research on verbal behavior in their appraisal:

> Although the focus of behavior analysis appropriately remains on what an individual does, . . . behavior analysts need to consider that "what subjects can be brought to do" may, in many situations, be a function of "what they can be brought to say." It seems that the analysis of verbal behavior in relation to reinforcement schedules may warrant a more central role in applied behavioral research. (p. 221)

Of course, a fundamental goal of one's intervention research may be to discover the contingencies of reinforcement that encourage participants to actually do the things that correspond with what they say. As basic scientists clarify the relations between verbal and nonverbal behaviors, there seem to be immediate opportunities to refine and expand upon previous analyses of correspondence training procedures (e.g., R. A. Baer,

Detrich, & Weninger, 1988; Ward & Stare, 1990).

Shull and Lawrence's proposed "alternatives to intermittent-reinforcement conception" of schedules also has applied implications. The traditional approach has been to classify intermittent schedules with respect to the periodic delivery of reinforcement following particular instances of a response class. This approach, however, does not seem to capture the richness of the potential functional relations between schedules and instances of targeted and untargeted behaviors. Topics such as relative resistance to change, adjunctive dispositions, and feedback functions are discussed as examples. This discussion buttresses Shull and Fuqua's (1993) point that "any manipulation of reinforcement contingencies or response opportunities has the potential to alter the frequencies of concurrently available responses" (p. 414).

In the school, home, and clinic, some adjunctive behaviors may involve classes of desirable responses that may, in turn, become targets for reinforcement contingencies. For example, contingencies that are applied systematically to concurrently available responses may increase the diversity of behaviors exhibited during activities like playing with toys (Goetz & Baer, 1973; Lalli, Zanolli, & Wohn, 1994) and writing English compositions (Glover & Gary, 1976; Maloney & Hopkins, 1973). Further study of adjunctive behaviors may contribute to the design of interventions that establish behavioral repertoires highly valued in society, such as problem solving and creativity (Stokes & Baer, 1977).

Chapter 5. Mazur presents a highly readable treatment of choice and self-control, which are topics that are increasingly prominent in *JABA*. Mazur's chapter complements Fisher and Mazur's (1997) discussion of choice responding very well. A continuation of the already productive integration of basic and applied research in the area is likely because, as Mazur put it, "the topics of choice and operant behavior are intimately intertwined. In everyday life, people can choose among a large, almost infinite set of operant behaviors, and they can choose not only which behaviors to perform, but under what conditions, at what rate, and for how long" (p. 131).

Of special relevance to application are Mazur's discussions on using concurrent reinforcement schedules to examine different response topographies and reinforcers (e.g., Mace, Neef, Shade, & Mauro, 1994; Neef, Mace, Shea, & Shade, 1992) and on the role of rule governance in choice (e.g., Horne & Lowe, 1993). These sections are meaningful because they acknowledge some of the complexities of analyses of choice in everyday situations (Fuqua, 1984; Mace, 1994). For example, whether an individual with developmental disabilities who is able to write a shopping list actually chooses to do so may depend on (a) the number of items to be purchased at the store (and need to be remembered without a list), (b) the consequences for making some or all of the purchases desired, and (c) whether self-instructions to write a list occur (e.g., Stromer, Mackay, McVay, & Fowler, 1998).

Chapter 6. Crosbie's authoritative contribution on negative reinforcement and punishment should be required reading for applied and basic researchers. In part, this is because of the scrutiny Crosbie gives to the analyses of aversive consequences and the importance he assigns to broad knowledge of the relevant research. Crosbie gives constructive commentary on the special circumstances surrounding this type of research (e.g., ethical concerns, dealing with institutional review boards, retention of participants) and on the various research methods and types of aversive stimuli used. He also makes a compelling argument that the field of behavior analysis will profit from continued research on the role of aversive events in

human learning. The topics under consideration intersect with several discussion papers that have appeared in *JABA*, including Shull and Fuqua (1993) on response cost, Lattal and Neef (1996) on negative reinforcement (and see Iwata, 1987), and Friman and Poling (1995) on response effort (see also Friman, Hayes, & Wilson, 1998, on anxiety; Smith & Iwata, 1997, on behavior disorders).

Stimulus Control

Much of the basic research on stimulus control has important implications for application, especially in the domain of teaching. If applied to socially significant verbal and nonverbal behavior, applications of the information contained in this section could (a) improve the methods used to establish stimulus control of such behaviors, (b) expand those repertoires, (c) make those repertoires more durable, and (d) contribute to a better understanding of the complexities of stimulus control.

Chapter 7. Saunders and Williams' account of simple and conditional discrimination procedures could help clinicians, teachers, and others meet the challenges of adapting the laboratory methods for application. I especially liked the expanded discussion of simple discrimination methods because of the contributions that might be made to the discrete methods currently being used in applied work (e.g., Sundberg & Partington, 1998, pp. 255–272, 1999). For example, the discussion of higher order simple discrimination performances examines the repertoires involved in learning set, stimulus generalization, abstraction, and functional stimulus classes. Of interest is (a) how best to establish such performances and (b) whether such complex repertoires facilitate the acquisition and expansion of the conditional discriminations likely to be introduced as teaching progresses.

Several articles in the "Developments in Basic Research" series provide discussions that expand upon the material presented by Saunders and Williams and contain suggestions for new domains of application. Examples of these new areas include the use of differential observing responses such as oral naming (Cataldo & Brady, 1994), the use of differential outcomes to enhance conditional discrimination learning (Nevin & Mace, 1994; and see Goeters, Blakely, & Poling, 1992), and setting generalization (Nevin & Mace, 1994; and see Rincover & Koegel, 1975). In addition, Smith and Iwata's (1997) conceptual article reviews and discusses the roles of contextual stimuli and establishing operations in the development of discriminative control.

Applied investigators have not been dissuaded from their interest in and use of establishing operations (e.g., Smith & Iwata, 1997; and see "Call for Papers," *JABA*, Vol. 32, p. 160) despite there being little basic research on the topic (e.g., McPherson & Osborne, 1988, and see Shull & Fuqua, 1993, pp. 413–414). For example, contextual stimulus control and establishing operations are central to the analysis and teaching of mands (see reviews by Brady, Saunders, & Spradlin, 1994; Shafer, 1994). Applied research might examine the contextual and establishing conditions that give rise to the repertoires involved in mands from the standpoint of the higher order simple discrimination performances described by Saunders and Williams. Doing so may help to clarify how Skinner's (1957) concepts of mands, tacts, and intraverbals may entail generative performances and whether there is also a role for the formation of stimulus equivalence classes in such performances (Hall & Chase, 1991).

There is ample interest in the kinds of discrete-trial methods described in Saunders and Williams' chapter. Nevertheless, applied research is needed to adapt, refine, and expand the laboratory methods, and then to

analyze those new methods in the home, clinic, and classroom. Furthermore, the applied impact of discrete-trial methods may be greatest if the techniques derived for practical use differ radically from those used in the laboratory. For example, Sidman (1994) mentions a few of the differences that may characterize use of the methods in the classroom:

> Reinforcements can vary; instructions can be given (with care; once having received instructions, pupils sometimes come to depend on them); with language proficient pupils, verbal rules can often short-circuit lengthy trial-and-error sequences; the presence of other students, alterations of the physical surroundings, and other situational variations that would be considered unacceptable in the laboratory may even facilitate the newly learned performances in more extensive environments. In general, any supposition that a teacher has to act like a basic scientist when applying scientific discoveries is unwarranted. (p. 534)

Thus, Sidman's recommendations suggest that the discrete-trial methods used in practical settings look vastly different from those used in laboratory investigations. The kinds of situational variations Sidman describes implicate some of the tactics described by Stokes and Baer (1977), in which a teacher explicitly arranges a student's learning environment to establish a generative behavioral repertoire (e.g., tactics called "training sufficient exemplars" and "loose training"). Analyses of discrete-trial methods that achieve generalized outcomes could contribute to the refinement and expansion of teaching curricula derived from behavior-analytic research (e.g., Charlop-Christy & Kelso, 1997; Freeman & Dake, 1997; Leaf & McEachin, 1999; Maurice, Green, & Luce, 1996; McClannahan & Krantz, 1999; Sundberg & Partington, 1998).

Chapter 8. Green and Saunders' essay on Sidman (1994) and stimulus equivalence is an excellent guide to this vast area of basic study; understanding its content could lead to the conceptualization and conduct of applied research. At the very least the chapter will enhance comprehension of the intricacies of equivalence research conducted in the laboratory. Green and Saunders also recognize the diversity of preparations that have yielded equivalence classes.

The prospects for applying equivalence methods have been addressed in two *JABA* discussion papers (Hayes & Hayes, 1993; Stromer, Mackay, & Remington, 1996). Hayes and Hayes suggest that applied researchers thoroughly acquaint themselves with the different procedures used for studying equivalence. Doing so will expedite their use of the methods in practical settings. Stromer and colleagues considered the role of verbal behavior in the formation and elaboration of equivalence classes in language and reading (and see Hall & Chase, 1991), suggesting further applied research involving complex stimuli, differential outcomes, and observational learning. The reader is also referred to a discussion that incorporates research on stimulus equivalence and relational frame theory in the analysis of private verbal behavior and its relation to emotional states such as anxiety (Friman et al., 1998).

Applied research that seeks to adapt the methods and concepts of stimulus equivalence has barely scratched the surface. This state of affairs exists despite nearly three decades of enthusiastic basic research in the area, including numerous demonstrations of the feasibility of applying the methods in teaching reading, spelling, writing, and arithmetic. There were even attempts to incorporate equivalence methods and concepts into reading curricula (Sulzbacher & Kidder, 1979; Wulz & Hollis, 1979). Since then, its

potential in teaching has been acknowledged, but relatively little applied research has ensued (e.g., D. M. Baer, 1982; Browder & Lalli, 1991; Goldstein, 1993; Singh & Singh, 1986; Stromer, Mackay, & Stoddard, 1992). It is promising, however, that a few recent creative examples of the use of equivalence methods in reading (Cowley, Green, & Braunling-McMorrow, 1992; de Rose, de Souza, & Hanna, 1996; Lalli, Casey, Goh, & Merlino, 1994), concept learning (Kennedy, Itkonen, & Lindquist, 1994), and arithmetic (Lynch & Cuvo, 1995) may help to generate more interest in the research area. Because of their reliance on discrete-trial methods, the scientist's interest in doing applied equivalence research may also increase if, as discussed earlier, adaptations of the methods prove to be acceptable to the teachers, clinicians, and parents who use them in natural settings (e.g., Sidman, 1994, p. 545; and see Stromer, 1991; Stromer et al., 1992).

The study by Lalli, Casey, Goh, and Merlino (1994) is noteworthy because the stimulus classes examined were established by teaching oral reading rather than the matching-to-sample procedures often used in the laboratory. The protocol was also unique because the pictures and printed words involved in reading instruction were used to analyze students' performances as they participated in daily activity schedules (e.g., see also MacDuff, Krantz, & McClannahan, 1993; McClannahan & Krantz, 1999). Not only did the students learn to read and show evidence of class formation, but they were also more compliant and less disruptive when printed words appeared on the activity schedules than when pictures appeared.

Chapter 9. Wixted's chapter on remembering and forgetting has the potential of advancing the behavioral analysis of such phenomena. Others have also discussed the virtues of a behavioral approach to memory (e.g., Branch, 1994; Catania, 1998; Delaney & Austin, 1998; Donahoe & Palmer, 1994; Palmer, 1991), but the area awaits programmatic applied research. The possibilities are numerous for fresh approaches to the question, and there are several areas of relevant empirical research, including protocol analysis (see comments below on verbal behavior), investigations of the effects of oral and written naming on other nonvocal behavior (e.g., Constantine & Sidman, 1975; Geren, Stromer, & Mackay, 1997; Stromer et al., 1998), and interventions to teach self-instruction strategies (e.g., Duarte & Baer, 1994; Taylor & O'Reilly, 1997). Finally, there is the intriguing notion that the formation of stimulus classes may influence what one remembers and forgets (Spradlin, Saunders, & Saunders, 1992; and see Branch, 1994, on semantic networks).

Other published papers on memory could complement Wixted's chapter because they emphasize the relevance of Skinner's (1957, 1969) ideas about verbal behavior in understanding and analyzing memory phenomena. For example, Palmer (1991) argues persuasively for a problem-solving account of many aspects of remembering and forgetting (and see Delaney & Austin, 1998; Donahoe & Palmer, 1994; and comments below).

Chapter 10. Applications of the signal-detection methods discussed by Irwin and McCarthy await the field of applied behavior analysis. Indeed, about the only mention of signal detection within the pages of *JABA* is found in Cataldo and Brady's (1994) enthusiastic critique of Critchfield's (1993) laboratory study of adults' verbal self-reports about their delayed matching performance (and see Critchfield & Perone, 1993). Signal-detection methods are widely used with humans outside behavior analysis in areas related to application (e.g., diagnostics and human factors). As suggested by Cataldo and Brady, there are numerous opportunities for behavior analysts to contribute to an understanding of the sensory, perceptual, cog-

nitive, and memory phenomena of interest to psychological science in general.

Signal-detection methods are suggested by Saunders and Williams (chap. 7) as a way of analyzing matching-to-sample performance. Such methods are also described in Wixted's (chap. 9) discussion of recognition memory (e.g., Baron & Surdy, 1990) and, briefly, in Critchfield and colleagues' (chap. 14) discussion of verbal reports. An important point is that the nature of a participant's discriminative responding may not be fully appreciated if only percentage correct is used as a dependent measure (Sidman, 1980). For example, as used by Sidman (1992) in a study of matching to sample, signal-detection methods permitted a detailed analysis of performances that were "incorrect" by the experimenter's definition and appeared to be disorderly and random. In contrast, signal-detection methods revealed orderly trends in the error data, suggesting that the location of a comparison stimulus in the display controlled its selection, rather than the sample stimulus. In teaching, sample stimuli (e.g., dictated names) often fail to control selections of the comparison stimuli (e.g., printed words) that correspond to the samples (e.g., Glat, Gould, Stoddard, & Sidman, 1994). Thus, any method that helps to understand the nature of such "errors" has potential practical value. In Sidman's words, "Plotting conditional-discrimination learning curves in a signal-detection space reveals relations among hits, false alarms, accuracy, and comparison preference that help to define a subject's progress" (1992, p. 173).

Verbal and Social Behavior

For applied and basic researchers alike, there will always be an opportunity to explore new conceptual approaches and methods in the study of verbal and social behavior. Some possibilities for applied research were examined in prior discussion articles (e.g., Cataldo & Brady, 1994; Friman et al., 1998; Lattal & Neef, 1996; Mace, 1994; Stromer et al., 1996). This section of the *Handbook* expands upon the methodology and conceptual frameworks of verbal and social behaviors.

Chapter 11. Weisberg and Rovee-Collier's treatise on methods used to study behavioral processes in infants and young children might be included on the reading list of anyone contemplating laboratory research with such participants. One limitation, however, is that there is virtually no discussion of methods used to study the particulars of verbal and social behavior, even though the chapter's placement in the book suggests otherwise. A chapter expanding upon these topics in infants and young children would have been a useful addition. Also, the chapter's emphasis on a specific population (infants and children), unlike others in the book, raises questions about methodological and process issues that might be unique to other populations. Considering the high concentration of behavior analysts in the fields of autism and mental retardation, a chapter on these topics would have been a valuable inclusion.

Weisberg and Rovee-Collier, however, have put together a rich collection of methods and insightful suggestions that should be generally useful for the study of behavioral processes in individuals whose intellectual, verbal, and social proficiencies are immature. Applied researchers who work with persons with developmental disabilities can appreciate the challenges involved and benefit from lessons learned in the laboratory. In addition to the methods reviewed by Weisberg and Rovee-Collier, there are several other informative *JEAB* papers that describe studies with infants and young children on topics such as delayed reinforcement (Reeve, Reeve, & Poulson, 1993), self-control (Darcheville, Riviere, & Wearden, 1993), and verbal behavior (Bentall, Lowe, & Beasty, 1985).

In another example, Lipkens, Hayes, and

Hayes (1993) conducted a long-term study involving discrete-trial methods to examine relational stimulus control (e.g., exclusion) in an infant. Similar procedures could be used to chart the course of important behavioral developments (e.g., generalized imitation, self-instruction, and other pivotal behaviors) in infants and toddlers with and without special needs (e.g., Rosales-Ruiz & Baer, 1997), and as they emerge with or without special teaching.

Chapter 12. The area of rule-governed behavior discussed by Shimoff and Catania has great potential for application (Lattal & Neef, 1996; Mace, 1994). The importance of the topic of rule governance for developmental (e.g., Vaughan, 1989) and clinical work (e.g., Hayes, Kohlenberg, & Melancon, 1989; Poppen, 1989) has long been recognized, but the needed research has not materialized (for a notable exception, see Taylor & O'Reilly, 1997). Unfortunately, the focus so far has largely been on the influence of verbal behavior on the schedule performance of college students pressing buttons.

Both basic and applied behavior analysts might consider the virtues of meeting the challenges of extending the study of rule governance to other populations (e.g., young children and individuals with developmental disabilities). As Mace (1994) concluded, "research on rule-governed behavior . . . has, perhaps, the greatest immediate applied relevance of any area of basic behavioral science" (p. 543). Understanding rule-governed behavior will contribute to a host of applied interventions including instruction following, self-instruction, self-control, and remembering. Laboratory research on the topic would also guide the development of explicit technologies for the generalization and transfer of behavior change (e.g., Kirby & Bickel, 1988; Stokes & Baer, 1977). For example, knowledge gained from analyses of rule-governed behavior could be applied to interventions that seek generalized verbal mediation performances (e.g., correspondence training; see R. A. Baer et al., 1988; Ward & Stare, 1990) and response classes made up of diverse and socially appropriate repertoires (e.g., generative toy play; see Goetz & Baer, 1973; Lalli, Zanolli, & Wohn, 1994).

Chapter 13. Catania's taxonomy of the scientific terms used in the study of verbal behavior hints at the wealth of applied and basic experimental questions awaiting those interested in Skinner's (1957) theory of verbal behavior and its contemporary derivations (e.g., Sundberg, 1991). The taxonomy contains useful definitions of a range of terms. The cross-referencing of the terms gives rise to linkages that suggest areas of fruitful empirical study (e.g., relations among coding, tacting, and remembering), and other potentially productive linkages are implied (e.g., relations among equivalence, intraverbal behavior, and verbal learning; adduction, abstraction, productivity, and recombinatory generalization). Research ideas also may be derived from (a) recent theoretical discussions about the role of verbal behavior in stimulus class formation and other complex behaviors (e.g., Horne & Lowe, 1996; Stromer et al., 1996), (b) renewed interest in interventions that concentrate on the function of verbal behavior rather than its structure (e.g., Charlop-Christy & LeBlanc, 1999), and (c) the development of specialized language interventions and broad curricula based on Skinner's ideas (e.g., Bondy & Frost, 1993; Brady et al., 1994; Shafer, 1994; Sundberg & Partington, 1998).

Chapter 14. In their chapter, Critchfield, Tucker, and Vuchinich describe recent advances in self-report methods. The methods covered raise intriguing research possibilities when considered in light of previous discussions of the use of self-report methods in clinical applications of behavior analyses (Cataldo & Brady, 1994; Friman et al.,

1998; Kirby & Bickel, 1995). The reader is also referred to papers published in a recent issue of *The Analysis of Verbal Behavior* that address verbal reports and protocol analysis (Austin & Delaney, 1998; Critchfield & Epting, 1998; Hayes, White, & Bissett, 1998) as well as remembering strategies (Delaney & Austin, 1998). That same issue also includes a series of commentaries on the "Current Status and Future Directions of the Analysis of Verbal Behavior" that address further research possibilities. For example, it seems worthwhile to combine the conceptual framework of rule governance (e.g., see chap. 12) and the methods used in protocol analysis in a program of applied research that focuses on interesting populations (e.g., individuals with mental retardation) and interesting behaviors (completing task-analyzed shopping programs; e.g., Taylor & O'Reilly, 1997).

Chapter 15. Schmitt reviews laboratory research on cooperation, competition, exchange, and other social phenomena. As Schmitt indicates, seminal studies in social behavior were conducted with children and individuals with mental retardation, but little of the subsequent research on basic processes involved those populations. In applied settings, social skills in and social interactions among individuals with developmental disabilities receive frequent attention in the research literature. However, the potential of integrating basic and applied research remains untapped. Analyses of the circumstances under which social choices are made, communicative skills displayed, and cooperative and altruistic behaviors engaged in could lead to a series of bridge and field studies. For instance, interventions based on observational learning (see Werts, Caldwell, & Wolery, 1996) might benefit from study of stimulus variables that influence a person's choice about whom they imitate or with whom they interact. Such choices may be affected by multiple features of the person being observed (e.g., facial expression, tone of voice, physical appearance, and gender; cf. McAlpine, Singh, Ellis, Kendall, & Hampton, 1992; Rojahn, Lederer, & Tassé, 1995).

New Directions

The chapters in this section should resonate with many applied behavior analysts. The section contains thought-provoking essays on (a) the analysis of interesting behaviors in simulated real-life settings, (b) methods derived from an ecological conceptual framework, (c) pharmacological research, much of which is directed toward clinically relevant issues, and (d) a primer on how persons might do interesting and important analyses of their own behavior.

Chapter 16. Bernstein describes research methods that lie somewhere between those used in the laboratory to study convenient behaviors (e.g., button pressing) and those used in real-life situations to study interesting behavior (e.g., interpersonal communication). For example, Bernstein describes dormitory arrangements in which assorted naturalistic behaviors (e.g., reading and writing, arts and crafts, playing a musical instrument, exercising) of college students were observed over extended periods to address such questions as how the students allocated their activity when access to some activities was restricted, and what types of relations could emerge among verbal reports and observational assessments of the behaviors involved (Bernstein & Ebbesen, 1978; Bernstein & Michael, 1990; and see McEntee & Saunders, 1997).

The topics covered in Bernstein's chapter suggest several linkages to contemporary applied behavior analysis. These include analogue functional assessment, teaching in simulated environments, the assessment and treatment of sleep and eating disorders, the intensive inpatient behavioral assessments of children with behavioral disorders, and investigations of a programmed-environments

approach to studying human learning (Findley, 1966; Stoddard, 1982). I encourage applied researchers to consider the analyses of basic principles that are possible using Bernstein's methods.

Chapter 17. Hackenberg's discussion of behavioral ecology complements earlier discussions of reinforcement (Shull & Lawrence, chap. 4) and choice (Mazur, chap. 5) with a thorough description of laboratory methods and the principles of the optimization. The areas covered include the analysis of choice, optimal foraging, and the delay-reduction hypothesis. Although Hackenberg argues for more laboratory study of humans using the methods and concepts of behavioral ecology, the approach also seems appropriate for analogue research like that described by Bernstein (chap. 16).

In addition, the methods of behavioral ecology might be adapted for the analysis of behavior in clinical, classroom, or residential settings. For example, it would be informative to replicate applied studies of student choice in the context of doing arithmetic problems associated with different rates and qualities of reinforcement (e.g., Mace et al., 1994; Neef et al., 1992). Research might examine dimensions of the contingencies operating in the class or home (e.g., rate, quality, response effort) that influence whether or not a student chooses to manipulate materials, engage in activities, and talk to people, all of which would be available to facilitate learning new skills (e.g., Favell & McGimsey, 1993; R. D. Horner, 1980; Vollmer, Marcus, & LeBlanc, 1994).

Consistent with chapters by Shimoff and Catania (chap. 12) and Critchfield et al. (chap. 14), Hackenberg also raises interesting research possibilities involving the verbal behavior of the participants, including the effects of instructions on optimal performance. Like college students performing laboratory tasks (Hackenberg & Joker, 1994), young children and individuals with intellectual disabilities may not always behave optimally (e.g., R. D. Horner, 1980; Vollmer et al., 1994). For example, when performing tasks like arithmetic and handwriting, a student may be indifferent to favorable and unfavorable reinforcement contingencies (e.g., more or less frequent reinforcers; greater or fewer reinforcers) unless supplemental interventions are used (Mace et al., 1994; Neef et al., 1992). One such supplemental intervention might involve verbal instructions (along with modeling and differential feedback) to teach a student to self-instruct ("I'll get more points if I do the hard problems and not the easy ones") while making choices among learning activities (e.g., Stromer et al., 1998; and see Duarte & Baer, 1994; Horne & Lowe, 1993).

Chapter 18. Higgins and Hughes present a cohesive discussion of laboratory research on behavioral pharmacology. Readers interested in application are also directed to reviews of treatment research derived from their research program (e.g., Higgins, Budney, & Bickel, 1994). This chapter could serve as a helpful primer on behavioral approaches to drug treatment and inspire new areas of investigation. Because of their connections to other chapters in the *Handbook,* I particularly recommend Higgins and Hughes' accounts of the studies involving social interactions (see Schmitt, chap. 15), analogue studies of naturalistic behavior, and the study of naturalistic behavior in residential settings (see Bernstein, chap. 16).

In addition to these virtues, Higgins and Hughes' chapter also demonstrates the relation between behavioral economics and behavioral psychopharmacology. A special issue of *JEAB* (Vol. 64, November 1995) was devoted to behavioral economics, but it receives little mention in the *Handbook* other than in Higgins and Hughes' chapter. Besides its use in drug research with humans, it would have been instructive had behav-

ioral economics been covered in a separate chapter. Doing so would have facilitated understanding of the particular methods involved, their relation to studies of behavioral ecology, and their broader potential for laboratory and field studies with humans. Incorporating behavioral economic theory into research on reinforcer preferences has also yielded beneficial applied outcomes (Tustin, 1994).

Chapter 19. In the final chapter, Roberts and Neuringer illustrate some methods used in self-experiments "motivated by scientific interest" (e.g., behavioral variability) and "by the desire to solve personal problems" (e.g., weight, sleep, and mood). The authors argue that self-experimentation methods can yield hypotheses about behavioral phenomena that can then be tested using more rigorous scientific methods. Additional benefits of self-experimentation are reflected by the self-management tactics often prescribed in clinical settings (e.g., Mahoney, 1974; Watson & Tharp, 1997). Self-experimentation may even help its practitioners reach new levels of personal adjustment. As Epstein (1997) reflected, Skinner was very proficient at self-management:

> B. F. Skinner was a remarkably productive, creative, and happy individual, in large part because of his expertise in self-management, a set of self-change skills that derive to some extent from his own scientific and theoretical work. . . . The extraordinary success Skinner had in applying self-management principles to his life should inspire us to take a closer look at the potential value such principles may have for society. (p. 545)

The Roberts and Neuringer chapter provides that "closer look," especially the section on "Methodological Lessons Learned" (pp. 645–646), which complement some of Skinner's (1956) "lessons." For example, the reader is advised to (a) "measure something you care about" and (b) "make data collection and analysis as easy as possible." These recommendations are consistent with Skinner's "thinking aid" (Skinner, 1987) that he used to "discover" what he had to say and to write it more efficiently and effectively (and see Skinner, 1981). Skinner's thinking aid involved classes of handwritten cues that were relevant to a topic on which he intended to write. The cues could be easily and continuously updated, revised, and rearranged as the final product emerged.

Conclusion

On balance, Lattal and Perone's (1998) *Handbook* fulfills its goal of providing a compendium of the methods currently used in human operant research and has obvious benefits for basic researchers. In addition, the *Handbook* is a valuable resource for applied researchers, some of whom may want merely to be informed on developments in the laboratory and others who are interested in bridging basic findings with applied study in order to more readily produce socially important outcomes. As a supplement to the handbook, applied (and basic) investigators are encouraged to read the series of thoughtful papers in *JABA* that discuss areas of basic behavioral science and their potential for application. Efforts to increase an understanding of behavioral processes in laboratory research could inspire innovative applied studies, which, in turn, could lead to the development of the intervention technologies that make good on the commitment of applied behavior analysts to help solve social problems (Johnston, 1991, 1993; Mace, 1991). The outlook for doing so has never looked better.

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